No. 716,765. Patented Dec. 23, 1902.

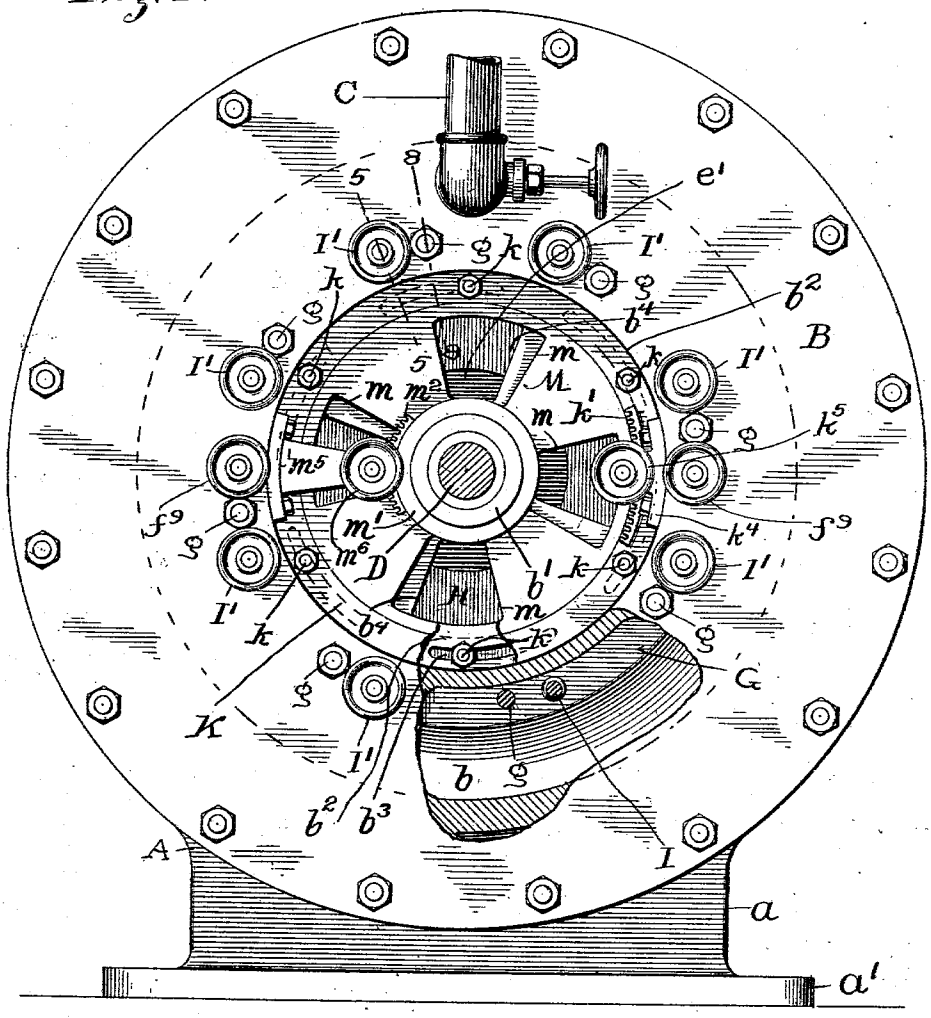
C. E. SARGENT.

STEAM TURBINE.

(Application filed Feb. 23, 1901.)

(No Model.) 6 Sheets—Sheet 1.

Fig. 1.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 716,765. Patented Dec. 23, 1902.

C. E. SARGENT.

STEAM TURBINE.

(Application filed Feb. 23, 1901.)

(No Model.) 6 Sheets—Sheet 2.

Fig. 2.

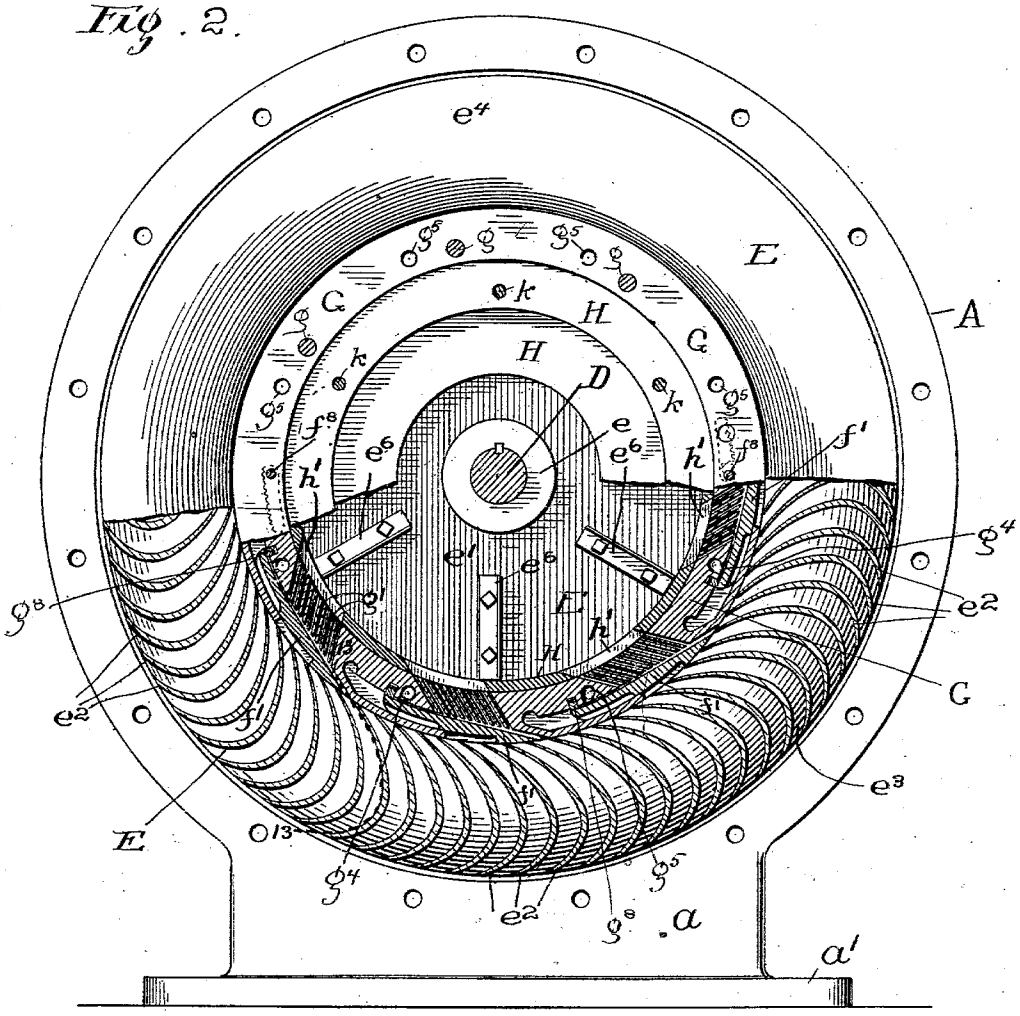
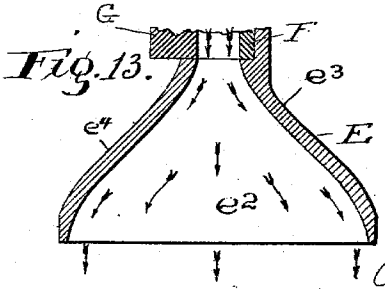


Fig. 13.



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No. 716,765. Patented Dec. 23, 1902.

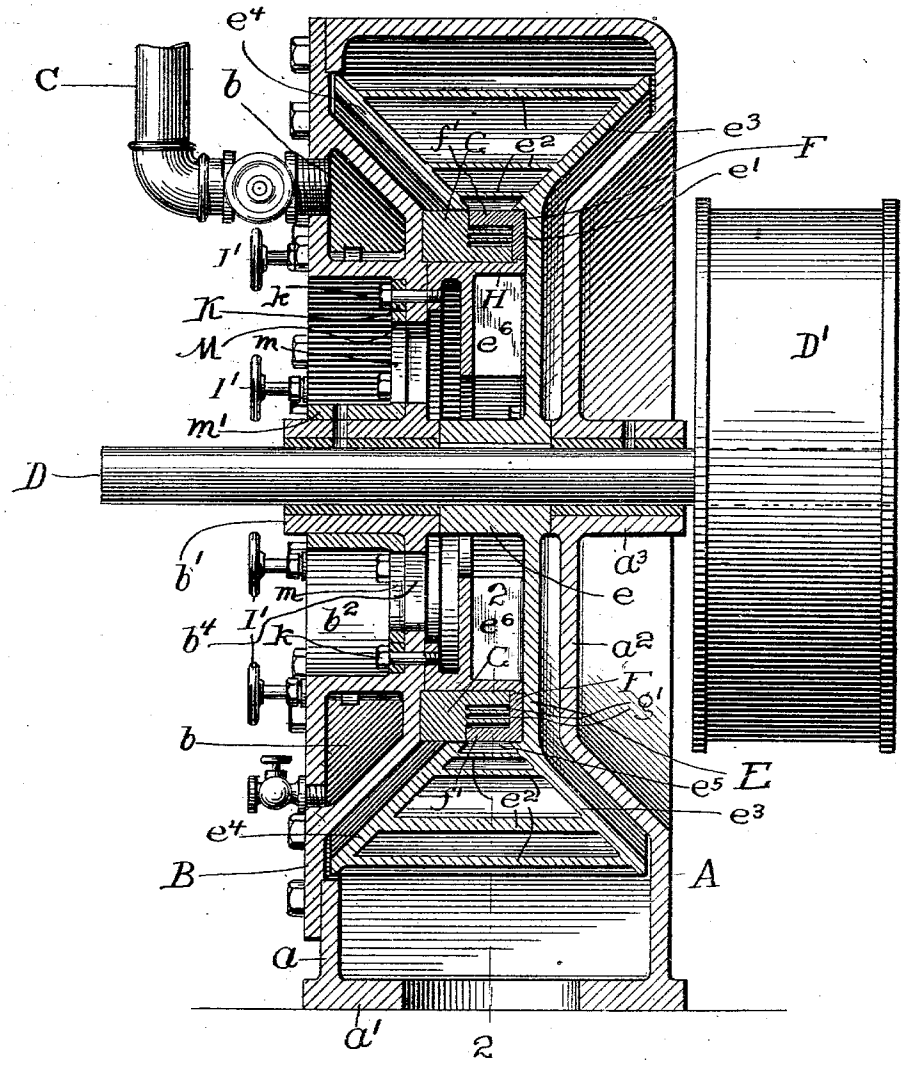
C. E. SARGENT.

STEAM TURBINE.

(Application filed Feb. 23, 1901.)

(No Model.) 6 Sheets—Sheet 3.

Fig. 3.



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No. 716,765. Patented Dec. 23, 1902.

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(Application filed Feb. 23, 1901.)

(No Model.) 6 Sheets—Sheet 4.

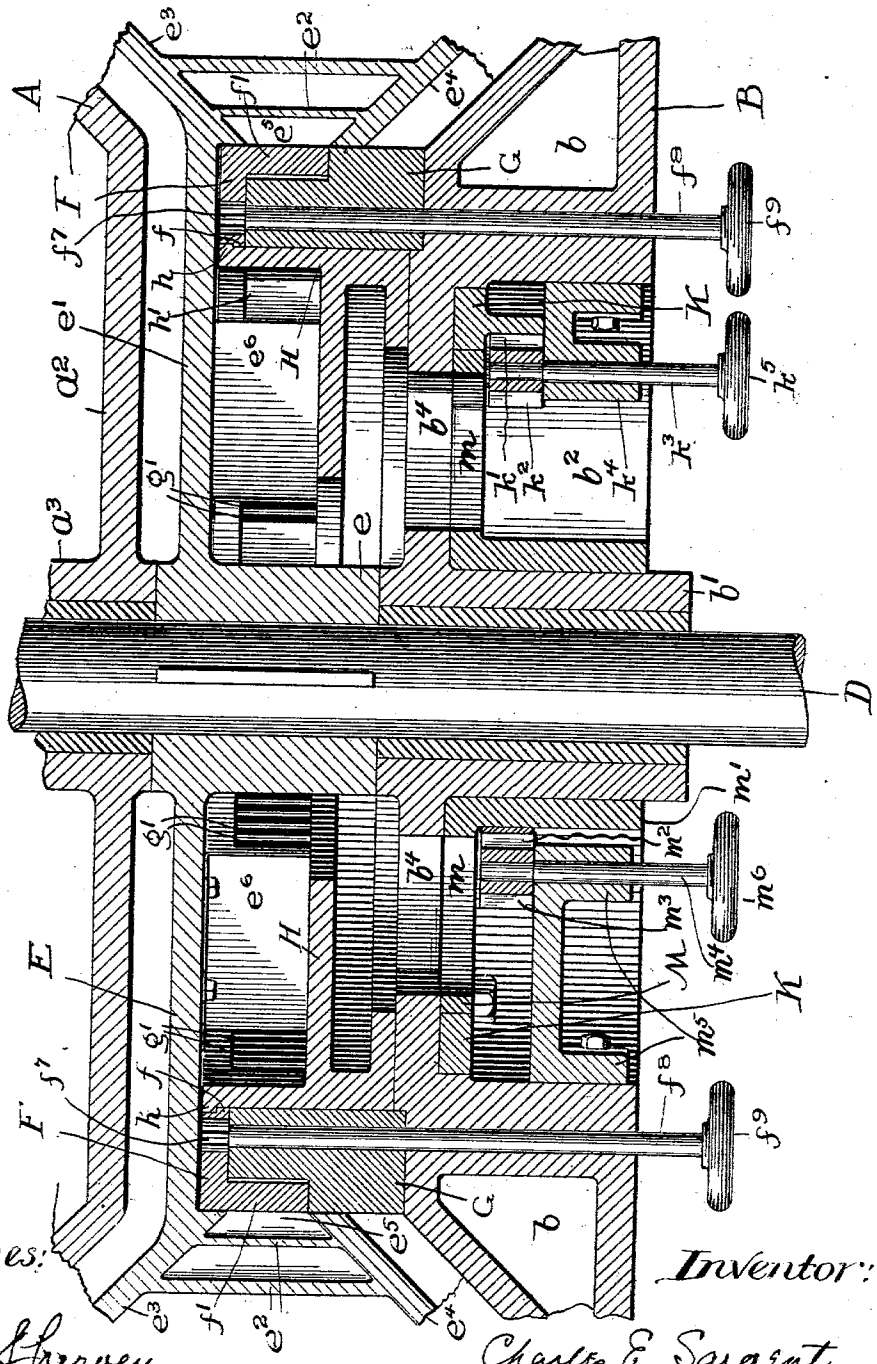


Fig. 4.

Witnesses:

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(Application filed Feb. 23, 1901.)

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FIG. 5.

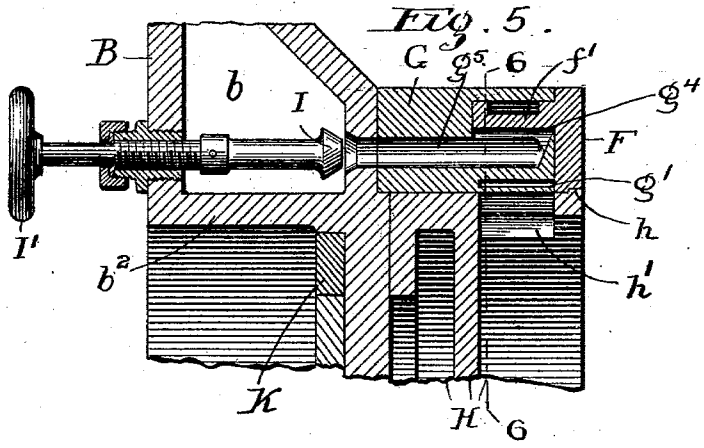


FIG. 6.

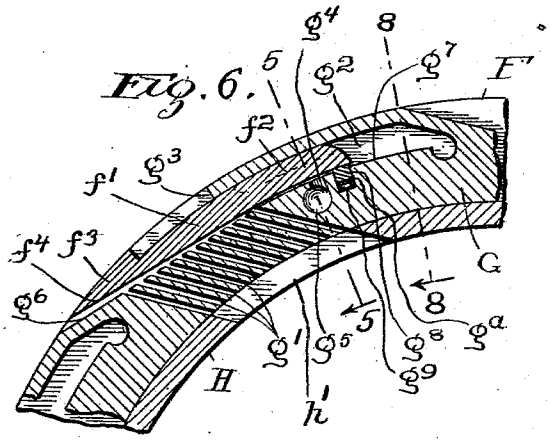


FIG. 7.

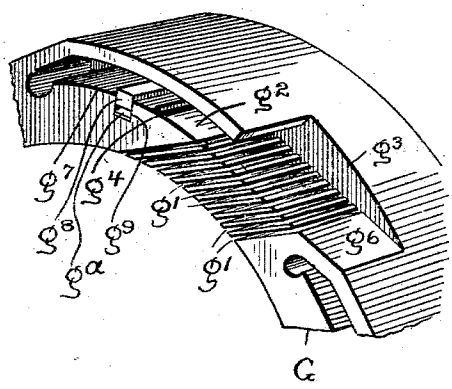
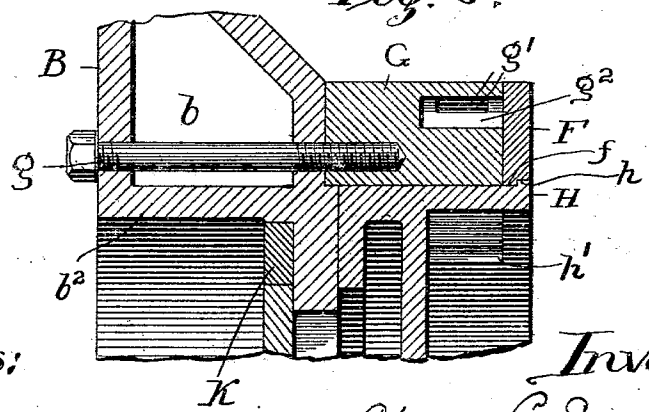


FIG. 8.



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No. 716,765. Patented Dec. 23, 1902.

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STEAM TURBINE.

(Application filed Feb. 23, 1901.)

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Fig. 9.

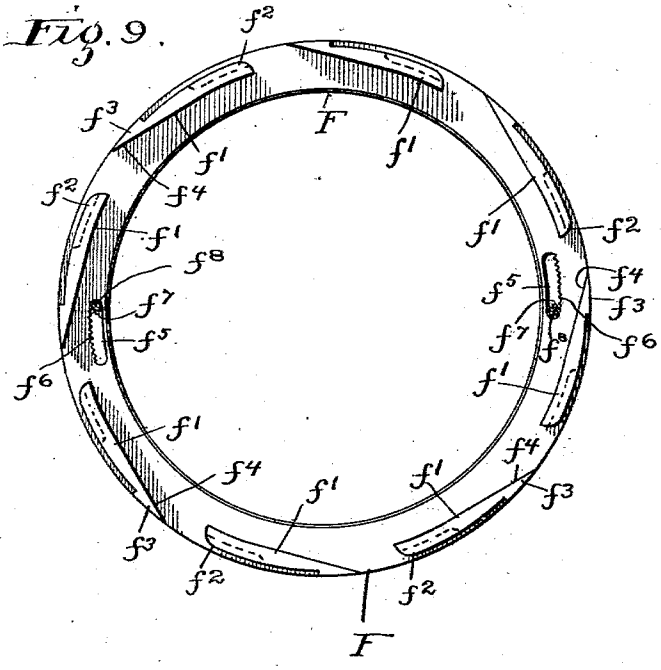


Fig. 10.

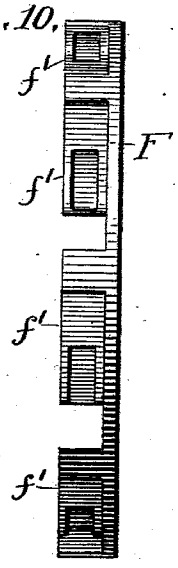


Fig. 11.

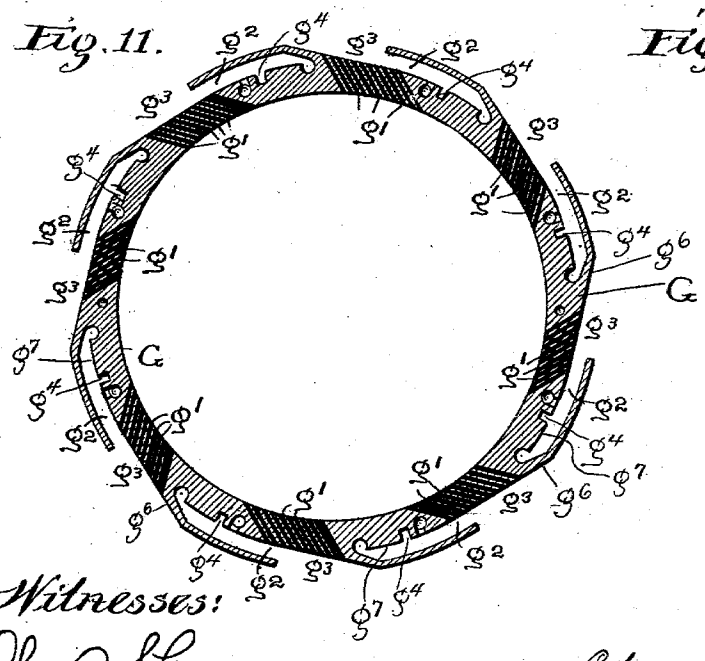
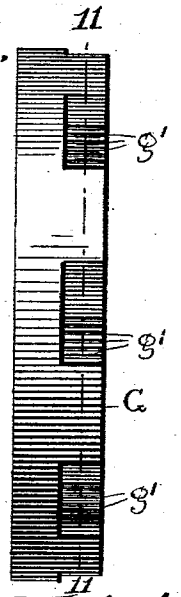


Fig. 12.



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UNITED STATES PATENT OFFICE.

CHARLES E. SARGENT, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO W. L. ABBOTT, OF CHICAGO, ILLINOIS.

STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 716,765, dated December 23, 1902.

Application filed February 23, 1901. Serial No. 48,396. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SARGENT, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Steam-Turbines, of which the following is a specification.

My invention relates to a device of the class known as "steam-turbines," and is particularly adapted in some of its features to the engines of this class using a jet of steam or other elastic fluid the impact of which is utilized to develop the power. In engines of this class one of the difficulties encountered is the necessity for great speed or velocity of rotation of the wheel in order to obtain the greatest efficiency, and it is my purpose, among other things, to provide means whereby a slower speed may be employed without material loss of efficiency. In engines of this class it is a recognized fact that there is an advantage in the use of what is known as an "expanding-nozzle"—that is to say, means for delivering the steam to the blades of the wheel through a passage which is larger at its discharge end than at the opposite end, allowing the steam to expand on its way through the passage.

It is another of my purposes to provide means whereby the amount of divergence or expansion in this passage or nozzle may be varied or adjusted to suit the requirements and to get the exact amount of expansion necessary to obtain the maximum efficiency.

It is another of my main purposes to so arrange and combine the parts of the engine as to produce what I will call an "outward-flow" turbine and to cause the jets of steam in this turbine to strike the blades centrally and outwardly.

In addition to these main purposes I have aimed to make certain subordinate and minor improvements, all of which will appear in the description of the complete device.

To such end my invention consists in certain novel characteristics embodied in the preferred form of engine herein described and the essential features of which will be pointed out in the claims.

The preferred form of engine in which I have embodied my invention is illustrated in the drawings, in which—

Figure 1 is a side elevation, partly broken away to reveal portions of the interior. Fig. 2 is a similar view with the front plate removed and the lower portion of the wheel cut in section in the line 2 2 of Fig. 3. Fig. 3 is a vertical diametrical axial section of the engine. Fig. 4 is a horizontal axial section. Fig. 5 is a detail radial section in line 5 5 of Figs. 1 and 6. Fig. 6 is a detail section through the valve-ring in line 6 6 of Fig. 5. Fig. 7 is a perspective of a portion of said valve-ring. Fig. 8 is a detail radial section of line 8 8 of Figs. 1 and 6. Fig. 9 is a face view of a movable valve-plate. Fig. 10 is an edge elevation of the same. Fig. 11 is a section of the valve-ring in the line 11 11 of Fig. 12. Fig. 12 is an edge elevation of said ring; and Fig. 13 is a view of one of the blades of the wheel flattened out to show the lateral extent of the passages between said blades, said view being a section taken in the curved line 13 13 of Fig. 2, extended or developed to bring the blade into the plane of the paper.

Referring to the drawings, A is a hollow shell, shown as provided with a base a and a base-plate a', adapted to be secured to a suitable foundation or support. One side of the shell is preferably set in about its central portion at a^2 and has a central bearing a^3. The other side of the shell is open to the full size of the wheel, but the opening is occupied by a front plate B, containing an annular steam chamber or chest b, supplied through a steam-pipe C. The middle portion of this front plate supports a bearing b', which, in conjunction with the bearing a^3 of the frame, carries a driving-shaft D, upon one end of which is shown a driving-pulley D' and upon the middle portion of which is fastened a turbine-wheel E. This wheel is made up of a hub e, a web e', and a series of curved blades e^2, supported between the flaring peripheral portion e^3 of the web e' and an opposite annular flaring portion e^4. The blades are curved, as shown in Fig. 2, so as to bring them from a direction approximately tangential to the circle of their inner ends to one approximately tangential in the opposite direction to the outside pe-

riphery of the wheel, and they are laterally flared or spread out in the shape of fans, so that the spaces between them while not varying greatly in thickness are much wider at the outer periphery of the wheel than at the inner. The flaring portions e^3 e^4 are shown as straight in radial planes, which, in connection with the curvature of the blades, causes the latter when spread out flat to take the shape shown in Fig. 13, their opposite edges at their inner ends starting from lines approximately parallel and diverging in reverse curves, so as to bring the said edges at their outer ends again into lines approximately parallel and much farther apart. The object of the lateral extension of the blades is to permit the steam to spread out laterally in its passage between them, and thereby slacken its speed. The approximately parallel position of the outlines of the outer ends of the blades causes the steam to be discharged in a radial direction, avoiding any loss of efficiency which might be caused by too great divergence and the consequent production of a partial vacuum.

Opposite the inner edges of the blades, between which is an annular slot e^5, are mounted a movable valve-plate F, Fig. 3, and valve-ring G, the valve-ring being secured to the front plate by bolts g, Figs. 1 and 8, and the valve-plate being guided by the valve-ring and an inner annular damper-plate H, the damper-plate and the valve-plate having interlocking ribs f h, Fig. 8, to prevent lateral movement of the valve-plate away from the valve-ring and toward the web of the wheel.

Figs. 6 and 7 show a section of the valve-ring, and the remainder of the ring is made up of other similar sections. A series of parallel oblique air-ports g' extend from the inner margin of the valve-ring into a lateral recess g^2, open at g^3, to the wheel opposite the ports g'. Back of these ports is a steam-port g^4, connected by a passage g^5 with the steam-chest b, Fig. 5. A valve I, operated by a hand-wheel I', serves to close this passage when desired. The inner wall of the recess g^2 at g^6 is flat and preferably tangential to the portion marked g^7, which, as well as the outer wall of the recess, is preferably arc-shaped and concentric with the ring. A packing-block g^8 is fitted to a socket g^9 in the inner side of the recess, and a spring g^a is interposed between said block and the bottom of the socket to press the block toward the recess. A valve-slide f', Fig. 6, is one of a series of similar slides projecting laterally from the annular valve-plate F, Fig. 9. These valve-slides are each fitted to slide in one of the recesses g^2, having one end f^2 fitted to the arc-shaped portion of the recess and a projecting end f^3 extending to the outer periphery of the valve-ring and flattened upon its inner side at f^4 substantially tangential to the inner arc-shaped side of the slide.

The valve-plate F is provided, as seen in Fig. 9, with arc-shaped slots f^5 f^5, and racks f^6 are formed upon the outer side of each slot, in which mesh pinions f^7 upon the inner ends of rods f^8, Fig. 4, journaled in the front plate and in the valve-ring and provided with hand-wheels f^9, by means of which they may be turned to rotate the pinions, and thereby move the valve-plate about the axis of the valve-ring, which is also the axis of the wheel. Looking at Fig. 6 it will be seen that this rotation of the valve-plate rotates the tangential inner side of the valve-slide about the common axis, the result of which is to separate this side of the slide from the opposite tangential side of the recess in the valve-ring and to increase the angle of divergence between the two. It is preferred that the arc-shaped portions of the slide and the recess be of sufficient extent so that in the ordinary manipulation of the valve the size of the opening between the slide and the side of the recess opposite the steam-port g^4 shall remain the same. In this way the rotary movement of the valve-plate with respect to the valve-ring will increase or decrease the flaring or expansion of the opening between the slide and the valve-ring, which forms the nozzle through which the steam is delivered to the blades of the wheel. The central portion of the front plate is offset inwardly, as seen at b^2, Figs. 1 and 3, and within this depression is guided a damper-ring K, connected, by means of bolts k, with the annular damper H. The bolts extend through arc-shaped slots in the front plate, (see b^3, Fig. 1,) so as to permit of the rotation of the damper-ring and damper about the common axis, and such rotation is effected by means of a rack k', Fig. 1, upon the damper-ring K and a pinion k^2, meshing therewith, (see Fig. 4,) on the end of a rod k^3, journaled in a bracket k^4, secured to the front plate, said rod terminating in a hand-wheel k^5. The damper-plate H is provided with a series of openings h', Fig. 6, opposite the air-ports g' through the valve-ring, and the rotation of the damper-plate closes or opens a portion, or all, of these air-ports.

The wheel E is preferably provided with a series of fans e^6, Fig. 2, to assist the movement of the air through the air-ports to the steam-nozzle, and further provision for checking the flow of the air is provided in the form of a circular plate M, Figs. 1 and 3, provided with a series of radial perforations m, adapted in certain positions to register with a corresponding series of perforations b^4 in the front plate. The circular plate M is shown as provided with a central hub m', journaled upon the bearing b' of the front plate and provided with a rack m^2, Fig. 1, meshing with a pinion m^3, Fig. 4, on a rod m^4, journaled in a bracket m^5, secured to the front plate, said rod bearing at its outer end a hand-wheel m^6, the rotation of which rotates the perforated plate and varies the size of the openings into the interior of the casing.

While I have described the exact details of construction in order to fully disclose the

preferred form of the invention, I do not consider said invention as limited to such details or to any particular arrangement or combination of the same, but believe certain features to be wholly independent of the specific construction illustrated.

I claim as new and desire to secure by Letters Patent—

1. In an engine of the class described, the combination with a suitable casing, of a wheel journaled therein and provided with a series of peripheral blades, increasing in extent, between the point at which said fluid strikes the blades and the point at which it leaves the same, the lines of said divergence being substantially reverse curves terminating at the periphery of the wheel in substantially parallel lines whereby the fluid may leave the blades without any divergence; substantially as described.

2. In an engine of the class described, the combination with a suitable casing and a wheel journaled therein and provided with a series of blades, of a valve-ring, a nozzle therein comprising substantially an arc-shaped recess in said ring, one side of which terminates in a substantially straight line, a port connecting therewith and an arc-shaped valve-slide within the said recess having a straight face opposed to the straight face of the recess and movable circumferentially in said recess to vary the angular relation of the straight faces; substantially as described.

3. In an engine of the class described, the combination with the frame, of a wheel journaled therein having a series of peripheral blades with outwardly and inwardly opening spaces between them, and a supporting-web offset to one side to leave the inner openings between the blades free of access, a recessed valve-ring suitably supported by the frame within the inner ends of the blades and provided with suitable ports directed toward said blades, a series of valves guided in the recesses of the valve-ring, a valve-plate to which said valves are connected, mounted in the frame and rotatable about the axis of the valve-ring, and means for rotating said plate to vary the valve-openings; substantially as described.

4. In an outward-flow turbine, the combination with a frame and wheel, the latter being provided with blades separated between their inner and outer ends, of a valve-ring mounted within the inner ends of the blades and containing a series of arc-shaped recesses, with one substantially straight side and ports connecting therewith, a valve-plate movable about the axis of the valve-ring and a series of arc-shaped valve-slides fitted to said recesses, each having a substantially straight side opposite that of the recess whereby the rotation of the plate varies the angular relation of said straight sides; substantially as described.

5. In an engine of the class described, the combination with a suitable frame and wheel, provided with blades, of a steam-nozzle directed toward the blades of the wheel provided with air-ports entering the interior of the steam-nozzle obliquely in the direction toward which the steam travels and means for regulating the quantity of air admitted to said nozzle; substantially as described.

6. In an engine of the class described, the combination with a suitable frame and wheel, provided with a series of blades separated between their inner and outer ends, of a ring mounted within the inner ends of the blades and provided with steam-ports directed toward said blades, and air-ports emptying into the steam-ports obliquely in the direction the steam travels and an annular damper fitted to the interior of the ring and rotatable therein to vary the extent of the air-openings; substantially as described.

7. In an engine of the class described, the combination with a suitable frame and wheel provided with a series of blades separated between their inner and outer ends, of a ring mounted within the inner ends of the blades and provided with steam-ports directed toward said blades, and air-ports emptying into the steam-ports obliquely in the direction the steam travels and a series of fans mounted upon the wheel within said ring and adapted to propel the air through said air-ports; substantially as described.

8. In an engine of the class described, the combination with a wheel having blades and a casing, of a series of nozzles and air-ports opening into the interior of said nozzles, means for varying the angular relation of the opposite walls of the nozzles, and means for varying the extent of the opening of the air-ports; substantially as described.

9. In an engine of the class described, the combination of a frame, a driving-shaft journaled therein and a wheel fast upon the driving-shaft, of a series of blades about the outer periphery of the wheel inclosing, in connection therewith, outwardly-diverging passages open at their inner and outer ends, nozzles for directing a fluid toward the inner ends of the blades, air-ports emptying into said nozzles and means for varying the angular relation of the walls of the nozzles and the extent of the opening of the air-ports; substantially as described.

10. In an engine of the class described, the combination with a frame and nozzle, of a suitably-journaled wheel provided with a series of lateral blades inclosed by side walls approximately parallel at the inner ends of said blades and diverging in reverse curves so as to be also approximately parallel at the outer ends of said blades; substantially as described.

11. In an engine of the class described, the combination with a suitable casing and a wheel provided with peripheral blades, of a valve-ring secured to the casing and containing arc-shaped slots, opening outwardly through its periphery, a rotatable valve-plate

having valve-slides, movable in said recesses to vary the size of the steam-ports therein, a toothed rack in said valve-ring, a pinion meshing therewith and a hand-wheel connected to said pinion for rotating said valve-ring; substantially as described.

12. In an engine of the class described, the combination with a casing, of a wheel provided with peripheral blades journaled in said casing, a steam-chamber, *b*, in said casing, a steam-pipe entering said chamber, a valve-ring, having a suitable nozzle to direct the flow of steam to the blades of the wheel, a port in said casing leading from the steam-chamber to the nozzle and a valve, I, seating on said port; substantially as described.

In witness whereof I have hereunto set my hand, at Chicago, in the county of Cook and State of Illinois, this 16th day of February, A. D. 1901.

CHARLES E. SARGENT.

Witnesses:
CHAS. O. SHERVEY,
S. BLISS.